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(54) WOVEN AND NON-WOVEN FABRICS CONSISTING OF STRETCHED TAPES MADE OF PLASTICS AND A PROCESS FOR PRODUCING THE SAME

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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to woven and non-woven fabrics, prepared without the use of any kind of adesives, composed of stretched plastic tapes and to a process for producing same.

Description of the Prior Art

Woven fabrics made of stretched plastic tapes have been widely used. However, such prior art products, because they are made of materials having low frictional coefficients, show slippage between the longitudinal and lateral tapes of the weave, which slippage results in deformed meshes. This tendency is particularly evident in stretched tape-clothes, and in some cases, results in the formation of large void spaces. Another problem is slippage between stacked industrial bags made of tape-cloth. To avoid these problems, various solutions have been proposed such as providing tapes having non-uniform or non-flat surfaces. Another attempted solution involves the application of a coating agent to increase the frictional coefficient between the longitudinal and lateral tapes. Other proposed solutions involve the application of adhesives to the surfaces or the lamination of a polymer film to the stretched tape-cloth to fix each longitudinal and lateral tape at their respective inter-sections. However, these prior attempts, while they have enjoyed some success in meeting the intended purpose, involve somewhat complicated processes and high production costs.

When non-woven fabrics are produced from stretched plastic tapes, it has, in the past, been necessary to use complicated methods such as applying adhesives or laminating a polymer film to the stretched tape fabric for fixing the longitudinal and lateral tapes at their intersections.

In a recently proposed method of uni-axially stretched film is laminated to a polymer film having a lower melting point than that of the former and then the material thus laminated is slit into tapes of smaller widths, followed by weaving such tapes into a fabric. However, this proposed method has met with only partial success because it does not avoid the tendency of the tapes to split in the direction of stretching during the stretching operation.

SUMMARY OF THE INVENTION

In accordance with one aspect of this invention there is provided a process for producing a woven fabric of stretched plastic tapes comprising: forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat; stretching said laminated film uni-axially; slitting said film into smaller widths to form the tapes; weaving said tapes in a manner that the lower melting point layers of the longitudinal tapes are facing the lower melting point layers of the transverse tapes; and heating the tapes so woven under pressure so that the lower melting point layers bond together at their points of contact.

In accordance with another aspect of this invention there is provided a process for producing a non-woven fabric of stretched tapes comprising: forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon

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being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat; stretching said laminated film uni-axially; slitting said film into smaller widths to form the tapes; arranging a plurality of tapes in a parallel relationship transverse to and on top of a plurality of tapes laid parallel to each other in an adjacent plane, with the lower melting point polymer layers of the tapes in one plane facing the lower melting point layers of the tapes in the adjacent plane; and bonding the tapes together by application of heat and pressure.

In accordance with another aspect of this invention there is provided a fabric having warp and woof elements comprised of laminated uni-axially stretched polymeric tapes, said tapes being formed from at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat, said tapes being positioned so that the warp and woof elements have their lower melting point layers in a facing relationship and fused together at intersecting points.

In accordance with another aspect of this invention there is provided a process for producing a fabric of stretched

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plastic tapes comprising: forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat; stretching said laminated film uni-axially; slitting said film into smaller widths to form the tapes; arranging said tapes in transverse relationship to each other in such a manner that the lower melting point layers of the tapes that are transverse to each other face each other; and heating the tapes so arranged under pressure so that the lower melting point layers bond together at their points of contact.

Splits occurring during the stretching operation detract from the commercial value and appearance of the product and cause tape breakages which result in interruptions in production. When stretching the laminated or composite polymer film to a given length, the polymer layer having a lower melting point is less likely to split than is the polymer layer having a high melting point. Accordingly, the laminated or composite films used in the present invention are less susceptible to such undesirable splits when uni-axially stretched than are films of the higher melting point material alone. The layer having the lower melting point can readily be bonded by being heated under pressure to the same lower melting point material of a superimposed fabric without causing thermal deterioration (reduced strength) in the polymer film layer having a higher melting point and without retarding molecular orientation of

the higher melting point layer during the subsequent stretching operation.

This invention will become more apparent from the detailed description to follow, taken in conjunction with the accompanying drawings and appended claims.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a non-woven fabric of the present invention; and

Fig. 2 is a perspective view of a woven fabric of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The laminated or composite film used in the present invention may be produced by heating and bonding under pressure two preformed polymer films or by the use of adhesives. However, the preferred process involves the feeding of at least two different polymers into a "T" die or a circular die so that the two polymers become melt-bonded to each other within the die. This process provides considerable advantages with respect to forming superior adhesion forces between the layers coupled with simplicity of operation. These advantages are particularly evident in the case of production of stretched tapes from polyolefins.

A and A' of the drawings indicate polymer layers having the higher melting or softening point and B and B' designate polymer layers having the lower melting or softening point. Each tape shown has two layers A and B or A' and B' laminated together. The structures of the composite tapes are such that the layers having a lower melting point in each tape face each other. In the case of a woven fabric, one layer having a lower melting or softening point faces another layer of the same melting or softening point so that bonds can be attained at every other intersection of the woven tapes. Non-woven fabrics may be produced with bonds at each intersection.

In such fabrics the layer A of the longitudinal stretched tape need not be the same kind of polymer as that of A' of the lateral stretched tape; and, likewise, the layer B need not be the

same kind of polymer as B'. However, it should be noted that layers A and A' have higher melting or softening points than those of layers B and B'. Layers A and A' afford the "stretch effect" while the layers B and B' provide the adhesive bonds. The melting or softening point of B and B: should be such that when bonded together by application of heat and pressure, no deterioration in the "stretch effect," or molecular orientation, of the layers A and A' due to the heat being applied will result.

The layers A and A' may be of any polymer capable of molecular orientation by longitudinal stretching. Such polymers include high density polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyvinyl alcohol, polyacrylonitrile, polyvinylidene chloride, polyamides, polyesters, and copolymers and derivative thereof, and other polymers capable of being formed into a crystalline film.

By the term "stretch effect" as used herein is meant a property of a polymer film by which, when the polymer film is stretched uni-axially and longitudinally to a length of several to several ten times the original length at a temperature which allows the molecular orientation, the polymer molecules in the film will become oriented in the stretching direction and the strength of the film in the stretching direction is greatly increased. One result of the "stretch effect" is that when a force is applied in a direction perpendicular to the stretching direction and tending to spread the film widthwise, the film tends to form splits in the longitudinal direction.

Polymers B and B' should be selected to be compatible with the polymer layers A and A'; so as not to impair the "stretch effect." Suitable polymers that may be used as B and B' include low density polyethylene, ethylene vinyl acetate copolymers,

ethylene acrylate copolymers, and any other polymers which permit the heat-bonding between layers B and B' while not impairing the stretch effect in the layers A and A'.

The present invention is not limited to laminates of two polymer layers, but also contemplates laminates wherein two different polymer layers B and C are bonded to the opposite sides of a core film A. Woven and non-woven fabrics of stretched tapes having three layers do not require the use of any adhesives for lamination to other fabrics of the same type; heat and pressure is sufficient for lamination. In the case of three layer tapes, layer B or C is bonded to another layer B or C of an adjacent fabric. This invention also contemplates the production of fabrics from four-layer composite films.

A woven fabric of two layer stretched tapes provides heat-bonded points between the layers having the lower melting or softening point at every other intersection in the fabric. In contrast, a woven fabric of three layer stretched tapes provides heat-bonded portions at every intersection.

The thicknesses of the various polymer layers may be varied to provide tapes suited for various stretching processes and of differing mechanical and bonding strengths.

After the stretched tapes made of such multi-layer films are woven, as shown in Fig. 2, or simply superimposed, as shown in Fig. 1, the composite is heated under pressure at a temperature above the melting or softening point of layers B, B' and C but not at so high a temperature so as to impair the "stretch effect" of the polymer layers A and A'.

The woven or non-woven fabric thus produced has great strength both in the longitudinal and lateral directions of the fabric, is light in weight, and has a proous texture. Furthermore, such a fabric can be used alone or in combination with paper or other clothes so as to further improve the strength thereof.

The tapes formed into the non-woven fabrics of the present invention may be placed at a right angle to each other or may intersect each other at any desired angle.

The present invention is illustrated in greater detail by the following examples.

Example 1

An extruder having a screw diameter of 120 mm and another extruder having a screw diameter of 90 mm were coupled to a circular die; with a high density polyethylene being extruded from the former and ethylene-vinyl acetate copolymer being extruded from the latter. The two polymer layers became melt-bonded inside the die, extruded into atmosphere and then blown. The product was a composite film having width of about 1800 mm when folded flat. It was found that the blowing of the composite film was accomplished as easily as blowing high density polyethylene alone. The composite film so obtained had a high density polyethylene layer of about 110 μ in thickness and an ethylene-vinyl acetate copolymer layer of about 10μ in thickness, the total thickness being about 120u. The composite film thus prepared was then uni-axially stretched to a length of nine times the original length, resulting in a film having a width of about 600 mm and a thickness of about 40u. This film was then slit into 120 stretched tapes having a width of about 5 mm. One group of the tapes was placed longitudinally on top of another group of such tapes which laid transversely with the ethylene-vinyl acetate copolymer layers of the longitudinal tapes facing the ethylene-vinyl acetate layers of the transverse tapes. The composite thus prepared was then heated to about 100°C under pressure to produce a non-woven fabric weighing 60 g/m^2.

The composite film thus prepared is not as susceptible to longitudinal splitting as is high density polyethylene film alone, thus enabling a high magnitude of stretching.

Example 2

Two extruders having a screw diameter of 120 mm were coupled to a "T" shaped die, with the polypropylene being extruded from the first extruder and the low density polyethylene being extruded from the second extruder. The two polymeis were melt-bonded together inside the die and extruded into the atmosphere in such a manner that the low density polyethylene layers were formed on the opposite sides of a core layer of polypropylene. Immediately subsequent to the extrusion, the composite film was quenched. The product was a composite film having width of 1800 mm and including one polypropylene layer of about 90u and two layers of low density polyethylene each having thicknesses of 30 u, the total thickness of the composite film being 150 u. The composite film was slit into tapes having widths of about 15 mm and then uni-axially stretched to a length of about nine times the original length to give 120 stretched tapes about 50u thick. These tapes were woven in a conventional weaving machine and then heated to about 120°C under pressure, thus giving a fabric weighing about 100 g/m^2. The product was found to be free of loose meshes, and to possess greater mechanical strength and resistence to longitudinal splitting than comparable fabrics of tapes made from polypropylene alone.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended alsims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for producing a woven fabric of stretched plastic tapes comprising:

forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat;

stretching said laminated film uni-axially;

slitting said film into smaller widths to form the tapes;

weaving said tapes in a manner that the lower melting point layers of the longitudinal tapes are facing the lower melting point layers of the transverse tapes; and

heating the tapes so woven under pressure so that the lower melting point layers bond together at their points of contact.

2. The process of claim 1 wherein said first polymer layer is of a material selected from the group consisting of high density polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyvinyl alcohol, polyacrylonitrile, polyvinylidene chloride, polyamides, polyesters, and copolymers and derivatives thereof and wherein the polymer having the lower melting or softening point is a member selected from the group consisting of low density polyethylene, ethylene-vinyl acetate copolymers, and ethylene-acrylate copolymers, and derivatives thereof.

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3. A process for producing a non-woven fabric of stretched tapes comprising:

forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat;

stretching said laminated film uni-axially;

slitting said film into smaller widths to form the tapes;

arranging a plurality of tapes in a parallel relationship transverse to and on top of a plurality of tapes laid parallel to each other in an adjacent plane, with the lower melting point polymer layers of the tapes in one plane facing the lower melting point layers of the tapes in the adjacent plane; and

bonding the tapes together by application of heat and pressure.

4. The process of claim 3 wherein said first polymer layer is of a material selected from the group consisting of high density polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyvinyl alcohol, polyacrylonitrile, polyvinylidene chloride, polyamides, polyesters, and copolymers and derivatives thereof and wherein the polymer having the lower melting or softening point is a member selected from the group consisting of low density polyethylene, ethylene-vinyl acetate copolymers, and ethylene-acrylate copolymers, and derivatives thereof.

5. A fabric having warp and woof elements comprised of laminated uni-axially stretched polymeric tapes, said tapes being formed from at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat, said tapes being positioned so that the warp and woof elements have their lower melting point layers in a facing relationship and fused together at intersecting points.

6. The fabric of claim 5 wherein said first polymer layer is of a material selected from the group consisting of high density polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyvinyl alcohol, polyacrylonitrile, polyvinylidene chloride, polyamides, polyesters, and copolymers and derivatives thereof and wherein the polymer having the lower melting or softening point is a member selected from the group consisting of low density polyethylene, ethylene-vinyl acetate copolymers, and ethylene-acrylate copolymers, and derivatives thereof.

7. A process for producing a fabric of stretched plastic tapes comprising:

forming a laminated plastic film of at least two layers of different polymers wherein one layer is a crystalline polymer capable of molecular orientation upon being stretched and wherein a second layer is a polymer of a lower melting or softening point than said first layer, the said melting or softening point of said second layer being such that when said layers are bonded together by application of heat and pressure no deterioration in the molecular orientation of said one layer takes place due to the applied heat;

stretching said laminated film uni-axially;

slitting said film into smaller widths to form the tapes;

arranging said tapes in transverse relationship to each other in such a manner that the lower melting point layers of the tapes that are transverse to each other face each other; and

heating the tapes so arranged under pressure so that the lower melting point layers bond together at their points of contact.

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Abstract of the Disclosure

There are disclosed woven and non-woven fabrics composed of stretched plastic tapes and a process for producing same. The products are made from plastic film laminates of at least two layers of different polymers having different melting points. The films are stretched uni-axially and slit to small widths. The stretched tapes so made are woven or laid one on top of the other, followed by heating under the pressure to produce the woven or non-woven fabrics.

Fig. 1

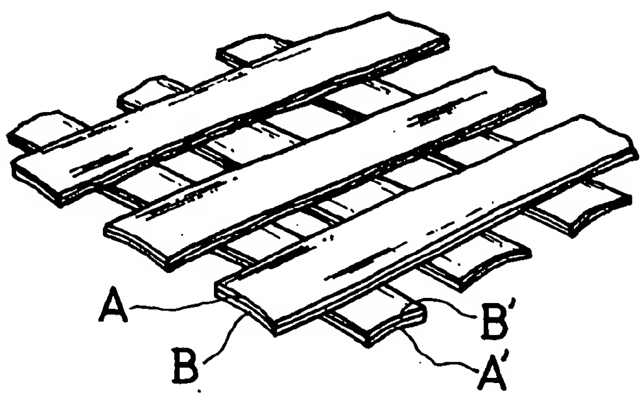
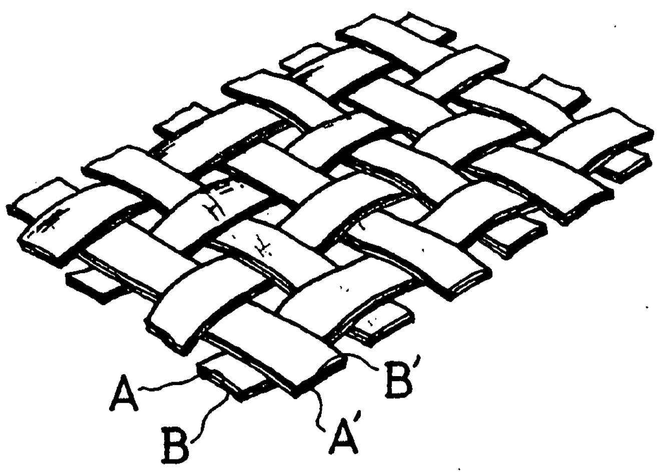


Fig. 2



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